

A comparison between the costs of dialysis treatments in Marche Region, Italy: Macerata and Tolentino hospitals

Concetta Maria Vaccaro¹ and Franco Sopranzi²

¹Fondazione Censis, Rome, Italy

²Struttura Complessa di Nefrologia e Dialisi, Ospedale di Macerata e Tolentino, Macerata, Italy

Abstract

Backgrounds. The main aim of this study was to estimate the costs of different dialysis modalities through the analysis of administrative databases in the Macerata and Tolentino hospitals, in Italy.

Methods. We retrospectively analyzed two main categories: medical direct costs (all the monetary costs whose consumption is wholly referable to dialysis treatment) and non-medical direct costs (all the costs that make treatment possible but that are outside the medical care sector), related to 2013. Attention was focused on the analysis of the extracorporeal dialysis methods (HD, HDF/AFB, HDF/MID/HFR) and the peritoneal dialysis (APD, CAPD).

Results. An analysis overall of economic costs (direct costs + indirect costs) for dialysis treatment, shows that the cost per week for Continuous Ambulatory Peritoneal Dialysis (CAPD) technique is less expensive for health-care budgets, followed by Automated Peritoneal Dialysis (APD). Regarding the extracorporeal dialysis methods, the treatment more affordable is HD.

Conclusions. Results obtained confirm that peritoneal dialysis technique is more convenient for health-care budget than extracorporeal dialysis. Furthermore, this study allowed to develop a methodology that could be a reference for similar studies.

Key words

- costs
- comparison
- extracorporeal dialysis and peritoneal dialysis

INTRODUCTION

In times of great emphasis on the health of the economic offer compatibility, any assessment of the costs of benefits and services of the organization takes central importance.

In particular, in the case of dialysis, it should consider that it is "life-saving" treatment, even at strategic level the patient's quality of life is highly influenced with respect to their ability to live a long time with a serious illness such as chronic renal failure, characterized by important technological features and such as exercise, also in terms of costs, has a significant impact on the size of the organization and operation of the services that it should provide them.

The goal of this work, made of input and in collaboration with Sopranzi Franco, Director of Complex Structure of Nephrology and Dialysis Hospital of Macerata and Tolentino and the administrative office of the Region, was therefore to provide a comparison between the costs of renal replacement therapies provided at the 2 hospitals.

It is a first pilot study, which allowed to evaluate the characteristics of the data made available by the Region and to develop a methodology that can be a reference for similar analysis in any location where there is economic accounting center cost and responsibility center.

MATERIALS AND METHODS

The general scheme is a cost-effectiveness pharmacoeconomical analysis that makes a comparison between the overall costs of treatments. However, the question of the peculiarities regarding the effectiveness of different treatments considered in this case was postponed to the evidence from the scientific literature, while we focused on the analysis and detection of only the costs of treatment [1, 2].

The comparison considered was based on the average unit cost estimates of dialysis treatments delivered in 2013 at hospitals, based on the analysis of accounting data. This analysis was made possible by the presence in analyzed structures and at the Marche Region of a cost

Table 1

General summary of the services performed from 01/01/2013 to 31/12/2013 to outpatients in the departments of Nephrology and Dialysis of Macerata and Tolentino

Wide Area 3 Macerata - Complex Structure of Nephrology and Dialysis Hospital of Macerata and Tolentino		
General summary of the services performed from 01/01/2013 to 31/12/2013		
Services provided to outpatients	Macerata Hospital	Tolentino Hospital
39.95.4 HD (hemodialysis bicarbonate and very biocompatible membrane)	7.258	5.042
39.95.5 HDF/AFB (hemodiafiltration, biofiltration with highly permeable membranes)	1.859	1.264
39.95.7 HDF/MID/HFR (hemodiafiltration with highly permeable membranes and very biocompatible)	769	662
54.98.1 APD (automated peritoneal dialysis)	4.903	2.311
54.98.2 CAPD (continuous ambulatory peritoneal dialysis)	1.888	2.386

Source: Marche Region

accounting centers and responsibility centers¹.

In the analysis it has made a general distinction between direct costs and indirect costs, where for direct costs are those costs directly attributable to the dialysis treatment, and indirect costs for those items of expenditure related to the hospital that, although not directly linked to treatment, could affect the final costs [1-3].

The different methods of extracorporeal dialysis provided at the two hospitals and the two main methods of peritoneal dialysis at home (CAPD, APD) performed by patients relating to the year 2013 have been taken into account.

In addition, attention has been focused on the analysis of the unit cost of each. We are not considered the costs associated with "startup" of therapy, such as the costs incurred in the first year as the training, the preparation of the treatment plan, the creation of an external shunt or the application of a fistula arteriovenous internal, nor the costs of services for which there is a charging separately (clinical or DRG) as the review of the vascular access, the change of the fistula etc [1, 2].

The analysis of the costs of processing operations performed in 2013 in two hospitals of Macerata and Tolentino was based on specific information related to the specific characteristics of the two dispensing structures considered, different in size and organizational characteristics that are obviously conditioning than the unit cost of treatments which it has been estimated.

The data necessary to reach at the determination of the costs are therefore classified as follows, starting from the general scheme proposed:

Direct costs

- personal;
- maintenance;
- materials;
- equipment (rental fee);
- drugs (including EPO);
- other medical supplies;
- lab exams;
- depreciation.

Indirect costs

- transport services;
- other non-medical materials;
- food services;
- hotel services (laundry, cleaning, storage, waste etc.);
- administrative services.

Of course, one of the main difficulties in this type of economic assessment lies in the concrete determination of the individual cost items to the level of disaggregation required to identify the average unit cost per treatment. In fact, it started from the overall costs relating to the hospitals and the departments of nephrology and dialysis, within which is only evaluated the work done on an outpatient basis, to reach to a detailed costs referred to a single treatment considered and defined by the code of the Nomenclature [4].

Starting point was therefore the large number of distinct benefits paid: for this purpose for each of the two operating units we used the General Summary of Services provided from the departments of Nephrology and Dialysis from 1 January to 31 December 2013, by code of the Nomenclature with fixed tariffs of outpatient services provided to outpatients (Table 1).

Direct costs

We constructed a matrix of reference regarding the unit costs as a preliminary analysis of the dialysis treatment named as "on desk costs".

We followed a "bottom-up" approach, each treatment was first divided into individual "elementary operations" and for each of these phases have been identified possible cost items [1, 2].

This work allowed to allocate the appropriate assessment of the cost items inserted in the regional database and to impute the costs to the single treatment and to make, where necessary, estimates for items not very well explained.

In particular each dialysis treatment include the use of: filter, lines, dialysate, needles, attachment kit/detachment, disinfectant.

In addition to these, for each dialysis treatment, it is necessary to use:

- 1 ampoule heparin;
- 1 bag of 2 liters of physiological solution;

¹ This data made available by the Department of Health of the Region and in particular by Paolo Gubinelli, Head of Management Control ASUR Marche Macerata Wide Area 3.

- 1 bag of 250 cc of saline solution;
- 1 syringe of 10 ml;
- 1 syringe of 2.5 ml;
- 1 syringe of 30 ml.

In adding to these items we considered the various types of filters used (such as Filters for Bicarbonate HD biocompatible and high-efficiency filters) and the related costs by averaging the cost of the different types used for the different methods, different from the codes of Nomenclature.

Thanks to the active analytical accounting at the Marche Region, it was possible to analyze the available database and identify, within each of the two structures considered and only for the dialysis departments, the costs for the year 2013 relating to the type of production factor used (personnel, maintenance, rental fees, drugs, medical and non-medical materials).

For the staff, we obtained for the two structures the staff information related to the number and type of professionals (Table 2), the daily hours actually used only in the dialysis activities, distinguishing therefore the activities done at the department. In details, the estimated time spent by each unit of staff assigned to the different departments and to different methods was realized by the Director of Complex Structure of Nephrology and Dialysis. Then it was rebuilt the "shift type" for the dialysis service, trying to identify how many staff members are present at the same time to provide the service.

More information on the gross annual cost of the professionals was provided by Management Control, considering the annual remuneration of each category.

Through this process it was possible to estimate the gross annual cost for professional referred exclusively to dialysis.

The costs evaluated with the bottom-up analysis were then compared with those contained in the database in the macro area products, solutions, including lines, filter and standard for performance package, always only for dialysis departments of Macerata and Tolentino.

Table 2

Staff by category in organic in the departments of Nephrology and Dialysis of Macerata and Tolentino

Staff	Macerata Hospital		Tolentino Hospital
	Nephrology	Dialysis	Dialysis
Director of Complex Structure	25%	25%	50%
Doctors	2	4 for HD+ 1 at 50% for PD	2 for HD+ 1 at 50% for PD
Nurses	6	22	12
Socio-sanitary operators (OSS)	2		2
Technicians		3	
Social worker	15%	10%	25%

Source: Marche Region

The voice "service" is listed in the database as "other costs" and was extrapolated the share related to dialysis services of the two structures.

For what concerns to the equipment, reference was made to the rental fees indicated in the dialysis database.

More complex analysis was the cost of the drugs used. Firstly we have chosen to distinguish between the cost of erythropoietin (EPO), far more significant, and the costs of other drugs administered to patients that perform outpatient dialysis.

Also important in this case was the scientific support done by Director of Complex Structure of Nephrology and Dialysis, which indicated the different dosing schedule that regulates the administration of EPO to the extracorporeal dialysis patients and peritoneal dialysis and has contributed to the extrapolation of the expenditure made by the two hospitals in 2013. For the definition of the costs of the other drugs, it has been used the regional database through detailed analysis of the individual items in the macro-health goods with the name of medicinal products, the quantities and value in 2013, again in reference to the single dialysis treatment.

With similar methodology have been extrapolated the costs for other medical supplies (such as bandages, surgical gloves, etc.).

The depreciation and amortization is also registered by the database and can be distinguished for both hospital Nephrology departments.

In the case of the EPO's costs, due to the different distribution of costs between the extracorporeal dialysis and peritoneal methods, have been used as a parameter the different frequency with which patients accessing to the hospitals.

For the evaluation of the cost attributable to clinical examinations we considered the types of examinations and their average frequency of these clinical examinations. The cost was then estimated from the data supplied by the region and it has been possible to distinguish the radiology and laboratory examinations required by dialysis, that, always following the clinical indications, we have chosen to attribute without any kind of differentiation to the patients who carry the different type of dialysis treatments.

Indirect costs

As regards the data for the determination of "indirect costs", it started again from the database and the documents made available by the Region.

In particular, the cost of transportation is determined by taking the total value of regional allocation of 2013 for dialysis patients related to Area Vasta No. 3, divided by territory and the number of transport operations carried out during 2013, both total and with reference to Macerata and Tolentino.

Through a detailed analysis of database entries arranged by cost center, the cost attributable to the non-medical materials was calculated (stationery, hygiene products, etc.) referring to the dialysis service of the two structures.

As for the cost of catering service (it is essentially a snack made available to patients who carry out dialysis

in the clinic) from the database entry macro "catering services and canteen" is an estimate was made using as criterion of the square meters and tipping the volume of activity. For the general health of hotel type services not related to laundry, canteen, wardrobe, waste collection, switchboard and telephone, heating, electricity and water, maintenance of the property, warehouse, etc. reference is made to the overall cost reported to the entire structure and is an estimate of the only service of dialysis was carried out, using as a criterion of rollover that of square meters of the service.

For the evaluation of the general administrative costs (general management, hospital management, etc.), always starting from the item referring to the whole structure, the criterion used was a mixture of square meters, and activity performed on an outpatient basis at each output hospital.

Adding all the costs considered, it was possible to obtain the full cost per treatment. For reasons of homogeneity all costs were compared to their per week "type" of treatment, for which monetary values obtained from the examination of extracorporeal techniques have been multiplied by 3 (average number of treatments per week) and the values for peritoneal dialysis were multiplied by 7 (average number of treatments) related to each of the two structures analyzed.

RESULTS

The cost of dialysis in the two hospitals

The results derived from the analysis and methodology described above and they are referred to the dialysis services provided in 2013 in the dialysis clinics of Complex Structure of Nephrology and Dialysis General Provincial Hospital of Macerata and Tolentino Hospital.

It is a total of 28 342 performance, of which 59.5% are of extracorporeal dialysis, the remaining 40.5% of

peritoneal dialysis (in both cases of various types).

In particular at the Macerata Hospital we performed 16 677 dialysis treatments and at the Tolentino Hospital we made 11 665 dialysis treatments, without major differences in the breakdown between extracorporeal and peritoneal treatments

The more practiced technique is found to be the hemodialysis bicarbonate with high biocompatible membranes (code of nomenclature 39.95.4) who reached the 73.0% of the total extracorporeal dialysis treatments and 43.4% of the total.

The *Tables 3 and 4* show the average values of the direct costs, indirect costs and total costs in the 2 hospitals and differentiated by each type of treatment.

Moreover, as already mentioned, in order to compare the costs of different dialysis treatments per week "type", the sum of all the costs (direct and indirect) is multiplied by 3 and 7 respectively for the extracorporeal treatment (HD) and for PD.

DISCUSSION

The cost of hospital staff (medical and paramedical) has the greatest weight on the direct costs, and as for the hospital in Macerata ranging between 46.0% in 3995.5 technique (hemodiafiltration, biofiltration with highly permeable membranes) and 53.0% in hemodialysis bicarbonate high biocompatible membranes (3995.4). The incidence of personnel costs for the PD is significantly lower than the direct cost and is equal to 15.6% and 23.0% respectively of the direct cost of CAPD and APD. Similar to the situation found at the Tolentino Hospital, in which is also present a smaller number of operators, with this cost component that varies between 56.9% of the total direct cost of hemodialysis bicarbonate with high biocompatible membranes and the 48.7% for some of hemodiafiltration techniques (3995.5). As

Table 3

Costs for treatment in Macerata hospital (average values in euro)

Treatments	Direct costs										Indirect costs							Total costs	
	Personal	Maintenance	Materials (lines + filter + performance standard package)	Rental fees	Drugs (not including EPO)	EPO	Other medical supplies	Lab exams	Depreciation	Total direct costs	Transport services	Other non-medical materials	Food services	Hotel services (laundry, cleaning, storage, waste etc.)	Administrative services	Total indirect costs	Total cost for treatment	Total costs per week "type" of treatment	
HD (39.95.4)	98.62	3.36	39.53	17.77	6.75	12.34	1.89	4.36	1.47	186.08	14.95	0.46	1.22	18.48	4.40	39.51	225.60	676.79	
HDF/AFB (39.95.5)	98.62	3.36	67.92	17.77	6.75	12.34	1.89	4.36	1.47	214.48	14.95	0.46	1.22	18.48	4.40	39.51	253.99	761.98	
HDF/ MID/HFR (39.95.7)	98.62	3.36	77.74	17.77	6.75	12.34	1.89	4.36	1.47	224.29	14.95	0.46	1.22	18.48	4.40	39.51	263.81	791.42	
APD (54.98.1)	13.29	-	62.00	Loan for use	1.94	3.55	0.11	4.36	0.09	85.35		0.03		1.72	0.41	2.15	87.50	612.52	
CAPD (54.98.2)	13.29	-	34.44	Loan for use	1.94	3.55	0.11	4.36	0.09	57.79		0.03		1.72	0.41	2.15	59.95	419.63	

expected it is lower the weight of the total costs for the peritoneal techniques, respectively 19% and 27.9% for the APD and CAPD.

Since it is assumed that for each type of treatment performed inside the same hospital, the time involved is substantially identical, the various cost items, by the personnel to drugs, to maintenance, are equally distributed in the different dialysis techniques. The cost differences are in fact attributable to the materials (lines + Filter + performance standard package) used for the different types of dialysis (from the simplest to the most complex). And in fact the weight of this item on the total of direct costs varies in the case of Macerata hospital from 21.2% in the case of the simplest technique, 3995.4, to 34.7% of some types of hemodiafiltration. Similarly for peritoneal dialysis, ranging from 72.6% of APD technique to 59.6% of CAPD. Also with regard to Tolentino hospital, which was already mentioned, it is a small hospital that performs a smaller number of dialysis treatments, this fundamental component of the cost of 3995.4 varies from 23.3% to 37.4% for the 3995.7 and is equal to 71.9% for the APD and to 58.8% for the CAPD.

In assessing the cost component represented by the equipment, it is estimated the rental fee for extracorporeal techniques and no cost for peritoneal dialysis, because the required equipment is loaned for use.

While the weight of other cost items considered between the PD and HD treatments are not so relevant, a certain importance is assumed by the drugs, and especially by the EPO, the value of which, as noted, was duly deduced from the analysis of regional data distin-

guishing between the consumption of it in HD patients and those patients in PD. In particular, the EPO cost represents about 6% of the total direct costs for the different techniques of extracorporeal and varies from 4 to 6% respectively for APD and CAPD in the case of Macerata, while in Tolentino ranges between 6% and 7% for HD and between 3% and 5% for the APD.

Finally, as regards the items that contribute to the calculation of indirect costs, there are two entries that take an important place: the transport services, provided only for patients who carry out dialysis in the clinic, and which account for 37.8% in Macerata and Tolentino for 35.2% of total indirect costs and general services. In this case, the weight comes in both structures to represent almost 50% of the total of indirect to the HD and the techniques about 80% for those of PD, while the total cost of these percentages are considerably reduced, especially for the peritoneal treatments.

CONCLUSIONS

In the combined direct costs for single treatment, the cheapest method is continuous ambulatory peritoneal (CAPD) with approximately € 58 for each hospitals and then automated peritoneal dialysis (APD) with nearly € 86. The direct comparison between the average costs of these treatments performed at home is basically solved in the comparison of the item relating to materials; in fact, the assistance of the staff is definitely more reduced, with a substantial proportion represented by the telephone consultations and, therefore, the related costs are considerably cut down, as shown in the *Tables 3* and

Table 4
Costs for per treatment in Tolentino hospital (average values in euro)

Treatments	Direct costs										Indirect costs							Total costs	
	Personal	Maintenance	Materials (lines + filter + performance standard package)	Rental fees	Drugs (not including EPO)	EPO	Other medical supplies	Lab exams	Depreciation	Total direct costs	Transport services	Other non-medical materials	Food services	Hotel services (laundry, cleaning, storage, waste etc.)	Administrative services	Total indirect costs	Total cost for treatment	Total costs per week "type" of treatment	
HD (39.95.4)	96.66	3.38	39.53	8.40	4.77	12.10	1.73	3.29	0.05	169.91	13.33	0.20	1.46	18.43	4.46	37.88	207.79	623.36	
HDF/AFB (39.95.5)	96.66	3.38	67.92	8.40	4.77	12.10	1.73	3.29	0.05	198.30	13.33	0.20	1.46	18.43	4.46	37.88	236.18	708.55	
HDF/ MID/HFR (39.95.7)	96.66	3.38	77.74	8.40	4.77	12.10	1.73	3.29	0.05	208.12	13.33	0.20	1.46	18.43	4.46	37.88	246.00	737.99	
APD (54.98.1)	16.36	-	62.00	Loan for use	1.40	2.96	0.16	3.29	0.00	86.17		0.02		1.75	0.42	2.19	88.36	618.53	
CAPD (54.98.2)	16.36	-	34.44	Loan for use	1.40	2.96	0.16	3.29	0.00	58.62		0.02		1.75	0.42	2.19	60.81	425.65	

4. To follow, between treatments in extracorporeal, it is less costly to hemodialysis bicarbonate, 3995.4, with an average direct cost equal to € 186.08 in Macerata and € 169.91 in Tolentino, while the cost is higher for the treatment with hemodiafiltration technique (HDF) 3995.7, amounting to € 224.29 to € 208.12 to Macerata and Tolentino.

The comparison of the total costs (direct + indirect) per week of treatment, which takes account of the different periodicity with which the treatments are carried out, keeps in fact the cost ranking unchanged: the dialysis treatment less expensive is CAPD, with an average cost of € 420 a week in Macerata and € 426 in Tolentino, followed by another home treatment: the average cost per treatment week for the APD is in fact equal to

€ 612 and € 618 in Macerata Tolentino.

The more convenient HD method is hemodialysis in bicarbonate with high biocompatible membranes (3995.4) € 677 per week of treatment in Macerata and € 623 in Tolentino, while the more expensive is the 3995.7, hemodiafiltration membranes with high permeability and high biocompatible with an average cost of € 791 in Macerata and € 738 in Tolentino.

See the *Tables 3 and 4* with the costs above.

Conflict of interest statement

The authors declared no potential conflict of interest.

Received on 14 March 2017.

Accepted on 13 October 2017.

REFERENCES

1. Censis. *Conviene l'autosufficienza? Un percorso verso l'integrazione dei trattamenti dialitici*. Milano: Franco Angeli; 2001.
2. Censis. *I trattamenti sostitutivi della funzione renale in Italia: aspetti clinici, economici e sociali*. Roma: Fondazione Censis; 2008.
3. Vaccaro CM (Ed). *Il valore del trapianto. I consumi sanitari e i costi dei trapianti di rene in Italia*. Roma: Carocci editore; 2013.
4. Regione Marche. Delibera della Giunta Regionale del 28 maggio 2012, n. 769. Nomenclatore Tariffario Regionale. *Bollettino Ufficiale della Regione Marche* n. 59, 15 giugno 2012.